Ballistic-Electron-Emission Microscopy and Spectroscopy of GaN Schottky Barriers*

L, D. Bell, R. P. Smith
Center for Space Microelectronics Technology, Jet Propulsion Laboratory
California Institute of Technology
Pasadena, CA 91109

B. T. McDermott, E. R. Gertner, R. Pittman, R. L. Pierson, and G. J. Sullivan
Rockwell Science Center
1049 Camino Dos Rios
Thousand Oaks, CA 91360

Challenges related to the formation of Schottky contacts to GaN are generally recognized, although a detailed understanding is lacking and much work remains to be done. Conventional electrical probes such as]- *V* and *C-V* have yielded spatially averaged values of barrier height, the reported values of which vary. This variation likely indicates the effects of heterogeneity y of interface properties. However, continued device development will require a high degree of interface uniformity.

Ballistic-electron-emission microscopy (BEEM) is a recently developed method, based on scanning tunneling microscopy, for probing interfaces with nanometer resolution. One great advantage of BEEM for the characterization of interfaces is that BEEM can isolate individual nanometer-scale areas for analysis, probing both local Schottky barrier height and its spatial variation. In addition, other properties affecting hot-carrier transport across an interface maybe probed. In the presence of interface heterogeneity due to defects, the high spatial resolution of BEEM is required to address the problem.

BEEM measurements have been performed on GaN material grown by Rockwell. An average Au/GaN Schottky barrier height of 1.1 eV has been measured by BEEM spectroscopy, compared with a value measured by *I-V* (on the same samples) of about 0.8 -0.9 eV. The large discrepancy between *I-V* measurements and BEEM measurements is an indication of interface heterogeneity. A more direct measure of heterogeneity is provided by BEEM imaging of this interface; images show electron transmission in most areas, although the intensity of transmission varies strongly.

Interestingly, BEEM characterization of other GaN material reveals no hot-electron transmission, although high-quality Schottky barriers can still be formed. Possibilities for this result will also be discussed.

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L. D. Bell, M/S 302-231
Jet Propulsion Laboratory
4800 Oak Grove Drive
Pasadena, CA 91109

Tel: 818-354-4761
Fax: 818-393-4540
email: dbell@vaxeb.jpl. nasa.gov